Probability Checkpoint 2

Question (1)

A fair die is rolled 12 times. Consider the following three possible outcomes:

(i)	5 2 6 3 2 1 4 1 6 5 3 4
(ii)	1 1 2 2 3 3 4 4 5 5 6 6
(iii)	6 6 6 6 6 6 6 6 6 6 6 6

Which of the following is true?

A: (i) is more likely than (ii) or (iii).

B: (ii) is more likely than (iii).

C: The three outcomes are equally likely.

D: It is absolutely *impossible* to get sequence (iii).

E: Both (a) and (b) are true.

Feedback

A : 0

✗ Not quite right. The die is fair. This means that all faces have an equal probability of occurring on any given roll (1/6). Since each roll is independent of the other rolls, the probability of the each of the three sequences shown is the same, $(1/6)^{12}$. The correct answer is (C).

B : 0

✗ Not quite right. The die is fair. This means that all faces have an equal probability of occurring on any given roll (1/6). Since each roll is independent of the other rolls, the probability of the each of the three sequences shown is the same, $(1/6)^{12}$. The correct answer is (C).

C : 10

✓ Good job! Each of the sequences is equally likely, with a probability of $(1/6)^{12}$ (since the 12 rolls are independent).

D : 0

✗ This is not quite right. Remember that each roll of the die is independent of all previous rolls of the die. Also, recall that the die is fair. This means that all faces have an equal probability (1/6) of showing up on any given roll. Think about the other choices. (c) is the right answer.

E : 0

✗ Not quite right. The die is fair. This means that all faces have an equal probability of occurring on any given roll (1/6). Since each roll is independent of the other rolls, the probability of the each of the three sequences shown is the same, $(1/6)^{12}$. The correct answer is (C).

Question (2)

Let A and B be two *disjoint* events such that P(A) = .20 and P(B) = .60.

What is P(A and B)?

A: 0
B: .12
C: .68
D: .80
E: None of the above.

Feedback

A : 10

✓ Good job! If two events are disjoint, then by definition, P(A and B) = 0 (the two events cannot happen together).

B : 0

✗ Not quite right. You may have computed P(A and B) for independent events by multiplying 0.20(0.60). But A and B are

✗ not independent because they are disjoint. Recall that if two events are disjoint, they cannot occur at the same time, In other words, the event 'A and B' never occurs, so P(A and B) = 0. The correct answer is (A).

C : 0

✗ Not quite right. You may have computed P(A or B) instead of P(A and B). Also you assumed that A and B are independent if you used the General Addition Rule P(A or B) = P(A) + P(B) - P(A and B) = 0.20 + 0.80 - 0.12 = 0.68. This is also incorrect since disjoint events cannot be independent. Recall that if two events are disjoint, they cannot occur at the same time. In other words, the event 'A and B' never occurs, so P(A and B) = 0. The correct answer is (A).

D : 0

✗ Not quite right. You may have computed P(A or B) instead of P(A and B). To calculate P(A and B) you need to determine if A and B are independent. Recall that disjoint events cannot be independent. If two events are disjoint, they cannot occur at the same time. So the event 'A and B' never occurs and P(A and B) = 0. The correct answer is (A).

E : 0

✗ Not quite right. If A and B are disjoint, then A and B do not occur at the same time, In other words, the event 'A and B' never occurs, so P(A and B) = 0. The correct answer is (A).

Question (3)

The following probabilities are based on data collected from U.S. adults during the National Health Interview Survey 2005-2007. Individuals are placed into a weight category based on weight, height, gender and age.

	Underweight	Healthy weight	Overweight (not obese)	Obese
Probability	0.019	0.377	0.35	0.254

Based on this data, what is the probability that a randomly selected U.S. adult weighs more than the healthy weight range?

A: 0.0889
B: 0.35
C: 0.254
D: 0.604
E: none of these

Feedback

A : 0

✗ Not quite right. Did you multiply 0.35 and 0.254? You may have been thinking that we want P(overweight AND obese) since we want to include both the overweight and obese people. But including both groups translates as P(overweight OR obese). Since these are disjoint events, we can add the two probabilities. The correct answer is (D).

B : 0

✗ Not quite right. 0.35 is the probability that the person is overweight (not obese). But we want to find P(overweight or obese). Since these are disjoint events, we can add the two probabilities. The correct answer is (D).

C : 0

✗ Not quite right. 0.254 is the probability that the person is obese. But we want to find P(overweight or obese). Since these are disjoint events, we can add the two probabilities. The correct answer is (D).

D : 10

✓ Good job! We want to find P(overweight or obese). Since these are disjoint events, we can add the two probabilities. 0.35 + 0.254 = 0.604

E : 0

✗ Not quite right. We want to find P(overweight or obese). Since these are disjoint events, we can add the two probabilities. The correct answer is (D).

Question (4)

In the population, 8% of males have had a kidney stone. Suppose a medical researcher randomly selects two males.

Let A represent the event "the first male has had a kidney stone."

Let B represent the event "the second male has had a kidney stone."

Which of the following is true about the two events?

A: A and B are disjoint.
B: A and B are independent.
C: Both (a) and (b) are true.
D: None of the above are true.

Feedback

A : 0

✗ Not quite right. The sample spaces for these two events overlap. If K = â€œhad a kidney stoneâ€ and N = â€œno kidney stoneâ€, then KK is in both sample spaces. In this problem the events are independent since the men are randomly selected from a large population, so the occurrence of A does not affect the probability of B. The correct answer is (B).

B : 10

✓ Good job! The occurrence of A does not affect the probability of B since the men are randomly selected from a large population. So the events are independent.

C : 0

✗ Not quite right. If two events are disjoint (part a is true), they must be dependent (part b is not true). In this problem the events are independent since the men are randomly selected from a large population. The correct answer is (B).

D : 0

✗ Not quite right. The occurrence of A does not affect the probability of B since the men are randomly selected from a large population. So the events are independent. The correct answer is (B).

The next three questions refer to the following information:

According to the information that comes with a certain prescription drug, when taking this drug, there is a 20% chance of experiencing nausea (N) and a 50% chance of experiencing decreased sexual drive (D). The information also states that there is a 15% chance of experiencing both side effects.

Question (5)

What is the probability of experiencing nausea *or* a decrease in sexual drive?

A: .10
B: .40
C: .55
D: .70
E: .85

Feedback

A : 0

Not quite right. We want to find P(N or D), which cannot be 0.10 because it has to be greater than either individual probability. Use the General Addition Rule P(N or D) = P(N) + P(D) â€“ P(D and N) = .20 + .50 - .15 = .55. The correct answer is (C).

B : 0

Not quite right. We want to find P(N or D), which cannot be 0.40 because it has to be greater than either individual probability. You may have made a probability table and added P(D and 'not N) to P('not D' and N). This is incorrect because P(N or D) includes the situation where both nausea and decreased sexual drive occur. Add P(N or D) to your answer or use the General Addition Rule P(N or D) = P(N) + P(D) â€“ P(D and N) = .20 +

.50 - .15 = .55. The correct answer is (C).

C : 10

Good job! We are given: P(N) = .20, P(D) = .50, P(N and D) = .15. We need to find P(N or D). Using the General Addition Rule: P(N or D) = P(N) + P(D) â€" P(D and N) = .20 + .50 - .15 = .55.

D : 0

Not quite right. You may have treated N and D as disjoint events and calculated P(N or D) = P(N) + P(D) = 0.20 + 0.50 = 0.70. But N and D are not disjoint because P(N and D) = 0.15. Use the General Addition Rule P(N or D) = P(N) + P(D) â€" P(D and N) = .20 + .50 - .15 = .55. The correct answer is (C).

E : 0

Not quite right. You may have misinterpreted what we mean when we say that P(N or D) is the probability of â€œnausea or decreased sexual drive or bothâ€ because you added these three probabilities. This is incorrect because P(N and D) is included in P(N) and in P(D). Use the General Addition Rule P(N or D) = P(N) + P(D) â€" P(D and N) = .20 + .50 - .15 = .55. The correct answer is (C).

Question (6)

What is the probability of experiencing only nausea?

A: 0.05

B: 0.10

C: 0.2

D: 0.35

E: none of these

Feedback

A : 10

Good job! The probability of experiencing only nausea is P(N) -

✓ P(N and D) = 0.2 - 0.15 = 0.05. You could also build a probability table to find P(N and 'not D').

B : 0

✗ Not quite right. You may have correctly determined that we want P(only N) = P(N and 'not D'), but you may have tried to calculate this probability multiplying P(N) and P(not D). This does not work because these events are not independent. Instead you could calculate P(only N) = P(N) - P(N and D) = 0.2 - 0.15 = 0.05 or build a probability table to find P(N and 'not D'). The correct answer is (A).

C : 0

✗ Not quite right. 0.2 is probability of experiencing nausea. P(N) includes the people who experienced both side effects. The probability of experiencing ONLY nausea is P(N) - P(N and D) = 0.2 - 0.15 = 0.05. You could also build a probability table to find P(N and 'not D'). The correct answer is (A).

D : 0

✗ Not quite right. You may have added P(N) = 0.20 and P(N and D) = 0.15, but this is incorrect because P(N) includes the people who experienced both side effects. The probability of experiencing ONLY nausea is P(only N) = P(N) - P(N and D) = 0.2 - 0.15 = 0.05. You could also build a probability table to find P(N and 'not D'). The correct answer is (A).

E : 0

✗ Not quite right. The probability of experiencing ONLY nausea is P(N) - P(N and D) = 0.2 - 0.15 = 0.05. You could also build a probability table to find P(N and 'not D'). The correct answer is (A).

Question (7)

What is the probability of experiencing neither of the side effects?

A: .10

B: .40

C: .45

D: .70

E: .85

Feedback

A : 0

✗ Not quite right. You may have computed P(N and D) = P(N)*P(D). This is incorrect because N and D are not independent events. Make a probability table. The correct answer is (C).

B : 0

✗ Not quite right. You may found P(exactly one side effect) = P(N and 'not D) + P('not N' and D) = 0.05 + 0.35. In your probability table identify P('not N' and 'not D). The correct answer is (C).

C : 10

✓ Good job! You want to compute P(neither side effect) = P((not N) and (not D)) = .45.

D : 0

✗ Not quite right. You may have incorrectly assumed that N and D are disjoint events and computed P(N or D). You want to compute P(no side effects). Try making a probability table and using it to find P(no side effects) = P('not N' and 'not D'). The correct answer is (C).

E : 0

✗ Not quite right. You may have interpreted â€œneither side effectâ€ as {N and 'not D, 'not N' and D, 'not N' and 'not D} and added these three probabilities from your probability table. But the sample space for this event is only ('not N' and 'not D). The correct answer is (C).

The next two questions refer to the following information:

For safety reasons, four different alarm systems were installed in the vault containing the safety deposit boxes at a Beverly Hills bank. Each of the four systems detects theft with a probability of .99 *independently* of the others.

Question (8)

What is the probability that when a theft occurs, *all four* systems will detect it?

A: $(.99)^4$
B: $(.99) * 4$
C: $(.01)^4$
D: $4*(0.01)*(0.99)^3$
E: $4*(0.99)*(0.01)^3$

Feedback

A : 10

Good job! P(all detect) = P(1st detects and 2nd detects and 3rd detects and 4th detects). Since the four systems work independently, P(all detect) = P(1st detects) * P(2nd detects) * P(3rd detects) * P(4th detects) = $(.99)^4$.

B : 0

Not quite right. Remember that, by definition, a probability must be between 0 and 1, inclusive. We want to find P(all detect) = P(1st detects and 2nd detects and 3rd detects and 4th detects). Since the alarms work independently, we can multiply the individual probabilities. The correct answer is (A).

C : 0

Not quite right. $(0.01)^4$ is the probability that none of the alarms detects the theft. We want to find P(all detect) = P(1st detects and 2nd detects and 3rd detects and 4th detects). Since the alarms work independently, we can multiply the individual probabilities. The correct answer is (A).

D : 0

Not quite right. $4*(0.01)*(0.99)^3$ is the probability that exactly one alarm fails to detect the theft. We want to find P(all detect) = P(1st detects and 2nd detects and 3rd detects and 4th detects). Since the alarms work independently, we can multiply the individual probabilities. The correct answer is (A).

E : 0

Not quite right. $4*(0.01)*(0.99)^3$ is the probability that exactly one alarm detects the theft. We want to find P(all detect) = P(1st detects and 2nd detects and 3rd detects and 4th detects). Since the alarms work independently, we can multiply the individual probabilities. The correct answer is (A).

Question (9)

The bank, obviously, is interested in the probability that when a theft occurs, *at least one* of the four systems will detect it. This probability is equal to:

A: $(.99)^4$

B: $(.01)^4$

C: $1- (.99)^4$

D: $1- (.01)^4$

E: none of these

Feedback

A : 0

Not quite right. $(0.99)^4$ is the probability of all four systems detecting a theft. We want to find the probability that â€œat least one system detects the theft,â€ which is the complement of â€œnone detect.â€ P(at least one detects) = 1 â€“ P(none detects) = 1 â€“ $(0.01)^4$. The correct answer is (D).

B : 0

Not quite right. $(0.01)^4$ is the probability that none of the systems detect the theft. We want to find the probability that â€œat least one system detects the theft,â€ which is the complement of â€œnone detects.â€ P(at least one detects) = 1 â€" P(none detects) = 1 â€" $(0.01)^4$. The correct answer is (D).

C : 0

Not quite right. 1 â€" $(0.99)^4$ is the probability that at most three of the four systems detect the theft, which is the complement of â€œall systems detect the theft.â€ We want to find the probability that â€œat least one system detects the theft,â€ which is the complement of â€œnone detects.â€ P(at least one detects) = 1 â€" P(none detects) = 1 â€" $(0.01)^4$. The correct answer is (D).

D : 10

Good job! We want to find the probability that â€œat least one system detects the theft,â€ which is the complement of â€œnone detects.â€ P(at least one detects) = 1 â€" P(none detects) = 1 â€" $(0.01)^4$. The correct answer is (D).

E : 0

Not quite right. We want to find the probability that â€œat least one system detects the theft,â€ which is the complement of â€œnone detects.â€ P(at least one detects) = 1 â€" P(none detects) = 1 â€" $(0.01)^4$. The correct answer is (D).

Question (10)

Only 40% of the students in a certain liberal arts college are males. If two students from this college are selected at random, what is the probability that they are both males?

A: 0
B: 0.16
C: 0.80
D: 0.64
E: none of these

Feedback

A : 0

Not quite right. If the probability is 0, then it would be impossible to select two males. Clearly, this is not right. Let A = â€œthe first person is a maleâ€. Let B = â€œsecond person is a maleâ€. We want P(A and B).The events are independent since the population is fairly large, so the answer is (0.4)(0.4) = 0.16. The correct answer is (B).

B : 10

Good job! Let A = â€œthe first person is a maleâ€. Let B = â€œsecond person is a maleâ€. We want P(A and B). Because the population is fairly large, the events are independent, and we can use the Multiplication Rule for Independent Events.

C : 0

Not quite right. Let A = â€œthe first person is a maleâ€. Let B = â€œsecond person is a maleâ€. We want P(A and B). You may have added probabilities instead of using the Multiplication Rule for Independent Events. The events are independent because the population is fairly large, so the answer is (0.4)(0.4) = 0.16. The correct answer is (B).

D : 0

Not quite right. You may have interpreted the probability of selecting two males as the complement of selecting two females, but the complement of two females is equivalent to â€œat least one male.â€ To find the probability of selecting two males, use the Multiplication Rule for Independent Events. The events are independent because the population is fairly large, so the answer is (0.4)(0.4) = 0.16. The correct answer is (B).

E : 0

Not quite right. Let A = â€œthe first person is a maleâ€. Let B = â€œsecond person is a maleâ€. We want P(A and B). Because the population is fairly large, the events are independent, and we can use the Multiplication Rule for Independent Events. The correct answer is (B).

Question (11)

Only 40% of the students in a certain liberal arts college are males. If two students from this college are selected at random, what is the probability that they are of the same gender?

A: .96

B: .52

C: .48

D: .36

E: .16

Feedback

A : 0

This is not quite right. It may help to go back and review the probability rules presented in this module. Consider the remaining options. (b) is the right answer.

B : 10

Good job! P(both of the same gender) = P(2 males or 2 females) = [disjoint events] P(2 males) + P(2 females) = [random selection â†’ independent] (.40 * .40) + (.60 * .60) = .16 + .36 = .52.

C : 0

This is not quite right. It seems that you have calculated the probability of one male and one female being selected rather than the probability of both selected people being of the same gender. Consider the remaining options. (b) is the right answer.

D : 0

This is not quite right. It seems that you have calculated the probability of both people being female. Remember that you want to find the probability of the selected people being the same gender, which means they could both be male, too. Consider the remaining options. (b) is the right answer.

E : 0

This is not quite right. It seems that you have calculated the probability of both people being male. Remember that you want to find the probability of the selected people being the same gender, which means they could both be female, too. Consider the remaining options. (b) is the right answer.